U.S. Department of Energy
Office of Electricity Delivery and Energy Reliability

Enabling Situation Assessment/Awareness for Utility Operators and Cybersecurity Professionals

Develop visualizations – engineered from integrating relevant data from disparate systems – which power system operators and/or cybersecurity professionals can use to make fast, accurate assessments of situations, enabling them to maintain situation awareness during unfolding events.

Background

Grid operators are struggling to derive meaning from data and make informed decisions on unfolding events in the finite amount of time available. Complexities in grid and cybersecurity operations are increasing and large volumes of data are being produced by many systems. The data are presented – using many displays – to the operators who must then perform the integration to understand what is happening on the system as a whole. To mitigate the impact of data overload on operator decision making, a visualization decision-support solution using cognitive systems engineering will provide the operators with a tool to quickly access an unfolding cyber incident and maintain situation awareness.

Objectives

Pacific Northwest National Laboratory (PNNL) and its project partners will design visualization decision-support tools that enable operators to effectively assess and act on integrated data coming from multiple disparate sources. The prototype will be built with industry partners and demonstrated in a utility operations center. The visualizations will be designed so that inputs can be adapted to the local data sources available, and so that fine-tuning of business processes can improve the response time during cyber-incidents. Working closely with electric power system operators and cybersecurity professionals, the resulting tool will be designed to provide value and deliver a strong impact to the industry.

Project Description

This project will build a real-time decision support tool based on cognitive systems engineering methods that will significantly reduce the demand on operators, enabling them to make informed decisions as events unfold. Using interviews and observations, PNNL will gather information, analyze data and generate creative ideas. The project team will perform the following tasks:

- Capture the critical relationships that define operation challenges
- Determine the cognitive tasks that operators must perform, and critical decisions that operators must make, in real time
- Establish the information requirements needed by the operators
- Determine conceptual design based on action and information relationships
- Explore decision aids
- Explore ways to improve human performance

Benefits

Visualization tool impact:

- Reduce the cognitive burden on the operators and enable them to make faster decisions and maintain situational awareness.
- Allow operators to reach the right decision and take appropriate actions with respect to cyber activity occurring on the electric power grid
- Benefits all utilities – Extensible to other utilities regardless of the vendors chosen in their existing systems

Partners

- Pacific Northwest National Laboratory (lead)
- Idaho National Laboratory (INL)
- Alstom
- Western Area Power Administration (WAPA)

Period of Performance

October 2014 – September 2017

Total Project Cost

$1,980,000

Cybersecurity for Energy Delivery Systems (CEDS)

CEDS projects are funded through the Department of Energy's (DOE) Office of Electricity Delivery and Energy Reliability (OE) research and development (R&D) program, which aims to enhance the reliability and resilience of the nation's energy infrastructure by reducing the risk of energy disruptions due to cyber-attacks.

Contact Information:

Carol Hawk
Program Manager
DOE OE R&D
202-586-3247
carol.hawk@hq.doe.gov

Eric Andersen
Principal Investigator
Pacific Northwest National Laboratory
509-375-2735
eric.andersen@pnnl.gov

For More Information:

- http://energy.gov/oe/technology-development/energy-delivery-systems-cybersecurity
- www.controlsystemsroadmap.net

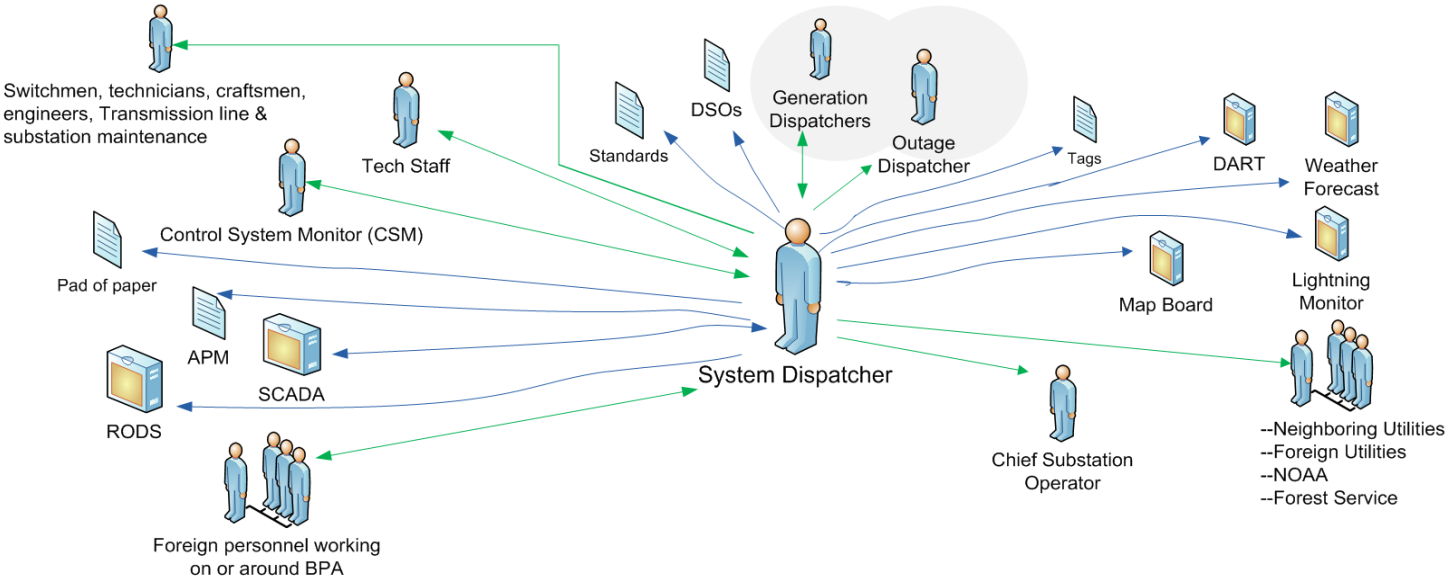

Figure 1: Interactions of Power System Operators

Technical Approach

Work with operators and cybersecurity professionals using cognitive task/work analysis designed to:

- Capture critical relationships that define the challenges real-time operators face
- Determine the cognitive task and critical decisions that real-time operators face
- Establish the information requirements needed by operators to take appropriate actions in a timely manner
- Characterize the relationships between action and information requirements that will lead to concepts for the design of user interaction
- Explore means for applying these design ideas into effective representations and decision aids
- Observe control center and cybersecurity operations in the field of practice to gain a realistic view of the complexity of the environment, patterns of interactions, and the strategies used to adapt to the demands of their work
- Using cognitive analysis methods to determine ways to improve human performance though training, user interfaces or decision aids

Cognitive Systems Engineering

There is a recognition of the nonlinear nature of human cognition with an awareness that exploring disparate systems may discover unknown interdependencies of processes that may not be self-evident.

The goal of cognitive systems engineering is to design systems that are effective and robust. People provide insights into understanding the work and informational needs of grid operators. This influences the solution – a solution that is a result of an iterative design cycle with each visualization prototype having an increased level of fidelity.

Cognitive analysis methods include structured interview techniques and critical incident analysis techniques that investigate past cases, critical decision methods, and cognitive field observation that examine performance in an actual work environment.

End Results

Project results will include the following:

- A context-sensitive visualization prototype built with industry partners and demonstrated in a utility operations center
- A whitepaper describing the iterative design process, prototyping and recommended operator visualizations
- Final product can be adapted to help other utilities build a visualization decision-support solution